Title of Invention: Compositions comprising a phosphonic compound, and acids as methods for plant growth and regulatory effects.

Cross-Reference to Related Applications:

Atwater; Mark L	July 30, 1996	5,541,149
Kowite , et al.	June 20, 1989	4,840,660

1) JOURNAL OF COTTON SCIENCE, Volume 1, Issue 1, 1997 Page: 9

2) 2003 COTTON DEFOLIATION/HARVEST AID SUGGESTIONS
Steven M. Brown, Extension Agronomist-Cotton, Philip H. Jost, Extension Agronomist-Cotton & Ag Crops, A. Stanley Culpepper, Extension Agronomist-Weed Science

3) 2002 Cotton Defoliation and Harvest Aid Guide D. L. Wright and B. J. Brecke, University of Florida, Institute of Food and Agricultural Sciences

Background of the Invention: Phosphonic compounds (ethephon) have been used for years as plant growth regulators, harvest aids and defoliation products. Atwater et.al has shown that when ethephon is formulated in sulfuric acid and adduct the Plant Growth Regulated (PGR) effects are increased. The present invention shows that the increased in the PGR effect shown by Atwater occurs with other acids as well as with the sulfuric acid combinations claimed in the Atwater patent(s).

Summary of the Invention: There is a need for increasing the defoliation and/or growth inhibition efficacy of phosphonic acid analog *(ethephon).* The present invention addresses this need by providing a composition formed by mixing *ethephon* and an acid in the same formulated agri-chemical product. This type of composition has significantly increased defoliation and growth inhibition efficacy

as compared to ethephon applied alone. In addition to or in place of *ethephon* the composition optionally comprises one or more other phosphonic acids, phosphonic acid derivatives, or salts thereof. Any of several acids that lower the pH of the spray solution to a pH of between pH 2 and pH 4 will produce the effect.

Detailed Description of the Invention The phosphonic acids, phosphonic acid derivatives, and their salts (hereinafter collectively referred to as "phosphonic compounds"). Phosphonic compounds such as ethephon ($ClCH_2CH_2PO_3H_2$ or any phosphonic acid derivatives that will break down into ethylene in or on an plant when applied to the foliage of a target plant. These effects are increased and the speed of development is faster when the phposphonic compound is formulated in any acid that will buffer the application solution (water carrier) to a pH between 4 and 1. The spray solution should be applied in agricultural or horticultural application to the foliage of the target plant.

Specific acids employed in the present invention include, but are not limited to: hydrochloric, muratic, nitric, phosphoric, phosphorous, poly-phosphoric, perchloric, citric and acetic acids.

Specific phosphonic acids and phosphonic acid derivatives employed in the present invention include, but are not limited to:

1. The bis(acid chloride) of (2-chloroethyl)phosphonic acid.

2. The pyrocatechol cyclic ester of (2-chloroethyl)phosphonic acid.

3. The 4-chloropyrocatechol cyclic ester of (2-chloroethyl)phosphonic acid.

4. The mixed ethyl and 2-hydroxyphenyl diester of (2-chloroethyl)phosphonic acid.

5. The mixed butyl and 2-hydroxyphenyl diester of (2-chloroethyl)phosphonic acid.

6. The mixed propynyl and 2-hydroxyphenyl diester of (2-chloroethyl)phosphonic acid.

7. The 2-chloroethyl monoester of (2-chloroethyl)phosphonic acid.

8. (2-bromoethyl)phosphonic acid.

9. The bis(phenyl) ester of (2-chloroethyl)phosphonic acid.

10. The tetrachloropyrocatechol cyclic ester of (2-chloroethyl)phosphonic acid.

11. (2-iodoethyl)phosphonic acid.

12. The saligen cyclic ester of (2-chloroethyl)phosphonic acid.

13. The salicyclic acid cyclic ester of (2-chloroethyl)phosphonic acid.

14. (Phosphonoethyl)phosphonic acid.

15. (Phosphonoethylthioethyl)phosphonic acid.

16. The 3-hydroxyphenyl monoester of (2-chloroethyl)phosphonic acid (which exists in polymeric form).

17. The bis(2-oxo-pyrrolidinylmethyl) ester of (2-chloroethyl)phosphonic acid.

18. The o-hydroxyphenyl monoester of (2-chloroethyl)phosphonic acid.

19. The mixed isopropyl and 2-hydroxyphenyl diester of (2-chloroethyl)phosphonic acid.

20. (2-fluoroethyl)phosphonic acid.

21. The mixed octyl and 2-hydroxyphenyl diester of (2-chloroethyl)phosphonic acid.

22. The mixed hexadecyl and 2-hydroxyphenyl diester of (2-chloroethyl)phosphonic acid.

23. The mixed tridecyl and 2-hydroxyphenyl diester of (2-chloroethyl)phosphonic acid.

24. The anhydride of (2-chloroethyl)phosphonic acid.

25. (2-chloroethyl)phosphonic acid.

26. The 2-chloroethyl-butylester, 2-hydroxyphenylester of phosphonic acid.

27. The 2-chloroethyl-2-chloroethylester of phosphonic acid.

28. The salicyclic acid cyclic ester of phosphonoamidic acid.

29. The mixed phenyl and 2-hydroxyphenyl diester of (2-chloroethyl)phosphonic acid.

30. 2-chloroethyl-dichlorophosphine.

31. The bis(pentachlorophenyl) ester of (2-chloroethyl)phosphonic acid.

32. (2-chloropropyl)phosphonic acid.

33. (2-phenylthioethyl)phosphonic acid.

34. The 2,3-pyridinedio cyclic ester of (2-chloroethyl)phosphonic acid.

35. (2-chloroethyl)thiophosphonic acid.

36. 2-chloroethyl-2,3-dibromo-4-hydroxy-2-butyenyl ester polymer.

Salts of the foregoing phosphonic acids are optionally employed in the present invention. Exemplary salts include, but are not limited to, the salts of alkali metals, alkaline earth metals, aluminum, ammonium, and zinc. The preferred alkali metals are lithium, sodium, and potassium, and the preferred alkaline earth metals are calcium and magnesium.

The combination of the present invention is used advantageously to control vegetation. The efficacy for growth control depends, among other things, on the amount of the combination applied per hectare (acre) (A), the relative proportions of acid to the phosphonic compound, the treatment time, and the type of plant to which it is applied. The defoliation and growth inhibition effects exhibited by the combination are significantly better than those observed when the phosphonic compound is employed alone.

The combination of the present invention is used as a plant growth regulator on vegetation, including but not limited to, apples, barley, blackberries, bromeliads, cantaloupes, cherries, coffee, cotton, cranberries, cucumbers, figs, filberts, grapes, guava, lemons, Macadamia nuts, ornamentals; peppers, pineapples, rye, squash, tangerines, tangerine hybrids, tobacco, tomatoes, walnuts, wheat, rape, corn, flax, maize, oranges, peaches, rubber, and sugarcane.

While the combination of the present invention can be used alone, it generally is applied to plants in conjunction with other substances water carrier which will usually include; wetting agents, emulsifiers, solvents and other surface active agents.

Typical surface active agents which may be utilized include calcium-lignin sulfonate, polyoxyethyleneoctylphenol ether and naphthalene-sulfonic acids and